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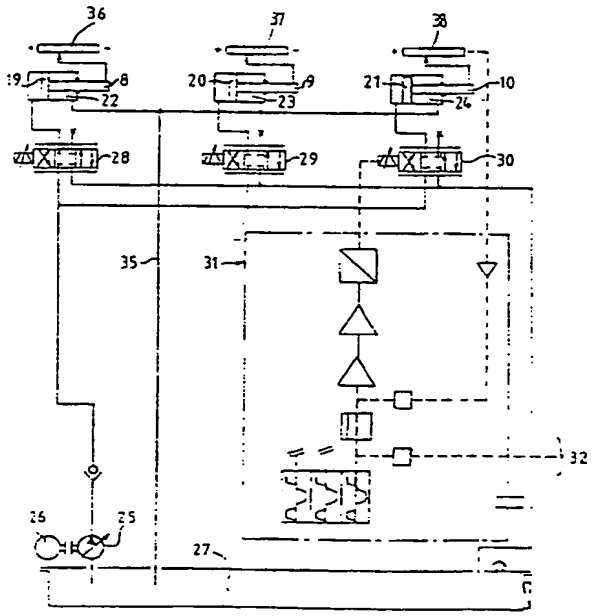
(54) Pump device.

(57) Three cylinder pump (1,2,3) device having displacer members (5,6,7) driven by hydraulic cylinders (22-24) and a control mechanism (31) programmed to ensure constant values for suction as well as delivery of the device, the control mechanism (31) comprising a position recorder (36,38) for the displacer members (8-10).

FIG. 1



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Pump device

The invention relates to a pump device having at least three displacer cylinders of the piston-, plunger-, piston membrane or similar type placed in parallel, of which displacer members are driven by pistons in hydraulic cylinders driven by a drive medium supplied by a motor driven pump, and in which suction-and pressure valves are present which are connected to the displacer cylinders at their suction-and pressure sides respectively, which device is provided with a control mechanism that has been programmed so that in use the quantities delivered as well as taken in per unit of time have constant or substantially constant values.

In pump device of this kind it is of importance that the quantity delivered per unit of time and the pressure furnished are as uniform as possible and thus that there are as little accelerations and decelerations of liquid masses as possible in the pressure duct as well as in the suction duct. If variations in quantity delivered and peaks in pressure can be avoided pulsation damping means are rendered superfluous totally or substantially. Then it becomes possible to apply pump device of this kind in those cases where such means can be used hardly or not at all such as at temperatures of over 100 degrees centigrade or at a very high viscosity it is also of interest that as a result of the non occurrence of pulsating means the duct systems are much less loaded dynamically.

In accordance with the invention for controlling the supply and discharge of the drive medium a valve controlled by the control mechanism is present for a valve each of the hydraulic cylinders and that each of the displacer cylinders is provided with a recording device for the position of the displacer, the outgoing signal of which is carried to the control mechanism.

The suction-and pressure valves which have been connected to the displacer cylinders may take the form of non return valves. In a preferred embodiment of the invention these valves have been carried out as non return valves which can be controlled from the outside, whereas the control mechanism is capable of providing a control signal therefor.

Sometimes it is desirable that the valves are allowed a certain lapse of time for their opening or closure. In that case it is of advantage if the control mechanism is established so as to provide at the end of each suction-or pressure stroke of the displacers a period of standstill in which the valves have an opportunity to open or to close. This is of particular interest in cases where high viscosity liquids have to be pumped.

A preferred embodiment is characterized in that the control mechanism has been established so that the suction stroke is carried out by the displacers in an accelerated way and that before the beginning of the pressure stroke a precompression takes place. This is of particular interest if the liquids are compressible to such an extend that a uniform delivery during the pressure stroke is adversely influenced.

The invention will be explained in view of the drawings in which:

fig. 1 shows schematically an embodiment of a pump device according to the invention

fig. 2 and 3 are schemes of the hydraulic systems with the control mechanisms of this pump device in two embodiments

fig. 4, 5 and 6 are diagrams in which on the horizontal axis the time and on the vertical axis the quantities delivered by the displacers per unit of time have been represented.

In fig. 1 three pump cylinders have been indicated with the reference nummerals 1, 2 and 3. In these cylinders are reciprocatingly movable displacers 5, 6 and 7 which are driven by rods 8, 9 and 10. Connected to the cylinders are the pressure valves 11, 12 and 13 leading to pressure duct 14 and the suction valves 15, 16 and 17 connected to the suction space 18.

The displacer rods 8, 9 and 10 are driven by the pistons 19, 20 and 21 (fig. 2 and 3) which are located in cylinders 22, 23 and 24 and are driven therein by a drive medium that is supplied by a pump 25 which is driven by an electric motor 26. As a rule the drive medium will be oil, whereas for the pump 25 an adjustable plunger pump may be chosen. The pump sucks the oil from a supply, in a reservoir 27, into which the oil also returns. In the ducts from the pump 26 to the cylinders 22, 23 and 24 and form these cylinders to the reservoir 27 valves 28, 29 and 30 have been mounted which are controlled by an electronic control mechanism 31 established in such a way that the cylinders 22, 23 and 24 receive by way of the valves 28, 29 and 30 the correct amount of drive medium or can discharge this medium to induce the speeds to the displacers 5, 6, 7 which they require to provide total quantities delivered and sucked up which are as uniform as possible.

Each of the cylinders 1, 2, 3 is provided with a recording device 36, 37, 38 connected to the rods 8, 9 and for the position of the piston 5, 6 and 7 in these cylinders. The outgoing signals of these devices are carried to the control mechanism 31.

In the schemes according to the figures 2 and 3 the control mechanism has been represented with its connections to cylinder 24 only in order to simplify the drawings. Identical connections exist with cylinders 22 and 23. From the control mechanism extend finally the connections 32 to the valves 11, 12 and 13 and 15, 16 and 17 in order to give the opening and closing commands to these valves.

The scheme in accordance with figure 2 represents the hydraulic system for the piston movements as represented in the figures 4 and 5. In these figures has been given in the form of diagrams how the control mechanism 31 has to be established to obtain the piston movements desired. In these figures have been given the time on the horizontal axis and the piston speeds on the vertical axis. These piston speeds are propartional to the quantities delivered per unit of time by the displacers 5, 6 and 7 as far as the parts of the diagrams are concerned which extend over the time axis and to the quantities sucked per unit of time for the parts below the time axis. The curves for the pistons 19, 20 and 21 have been indicated here with the reference numerals for the pistons themselves. In order to keep the sum of the deliveries of two pistons constant (the third piston then carries out a suction stroke) it is necessary to include a short period of standstill in the piston movement (33 in diagram figure 4). This is not the case if the piston movements are controlled as represented in figure 5 (a so called oblique sinusoidel movement).

In the embodiment as represented in figure 6 precompression phases 34 are created which are used by the displacers to precompress the liquid sucked in prior to its discharge through the pressure valves. In this case the suction strokes are accellerated. As the precompression does not lead to delivery the total delivery of the pump device remains constant.

Belonging to this embodiment is the hydraulic system according to figure 3. As shown therein also the return ducts 35 are carried through the valves 28, 29 and controlled by the control mechanism 31 so that the oil is not returned directly to the reservoir 27. In the case of figure 2 the cylinders are interconnected at their drive rod sides so that no direct return duct is required and one or two pressing cylinders may drive one or two sucking cylinders.

If a return duct indicated with 35 is present, this is provided with an overload valve (not represented).

Claims

1. Pump device having least three displacer cylinders of the piston-, plunger-, piston membrane or similar type placed in parallel of which displacer members are driven by pistons in hydraulic cylinders driven by a drive medium supplied by a motor driven pump and in which suction-and pressure valves are present which are connected to the displacer cylinders at their suction-and pressure sides respectively, which device is provided with a control mechanism that has been programmed so that in use the quantities delivered as well as taken in per unit of time have constant or substantially constant values, characterized in that for controlling the supply and discharge of the drive medium a valve (28, 29, 30) controlled by the control mechanism is present for each of the hydraulic cylinders - (22, 23, 24) and that each of the displacer cylinders (1, 2, 3) is provided with a recording device for the position of the displacer, the outgoing signal of which is carried to the control mechanism.

2. Pump device according to claim 1, characterized in that the suction-and pressure valves - (11, 12, 13 and 15, 16, 17) have been carried out as non return valves which can be controlled from the outside and that the control mechanism is established for providing a control signal therefor.

3. Pump device according to claim 1 or 2, characterized in that the control mechanism (31) is established so as to provide at the end of each suction-or pressure stroke of the displacers (5, 6, 7) a period of standstill in which the valves have an opportunity to open or to close.

4. Pump device according to any of the preceding claims characterized in that the control mechanism (31) has been so established that the suction stroke of the displacers (5, 6, 7) is carried out in an accellerated way and that before the beginning of a pressure stroke a precompression takes place.

FIG. 1

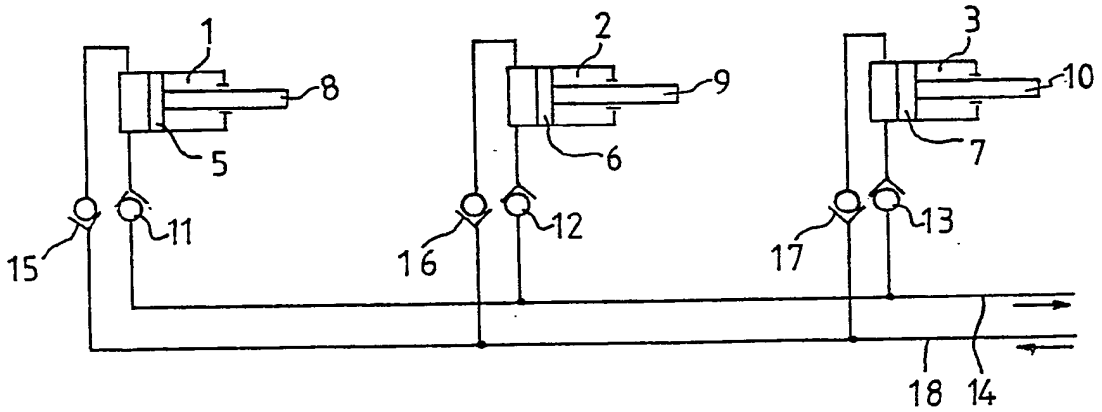


FIG. 6

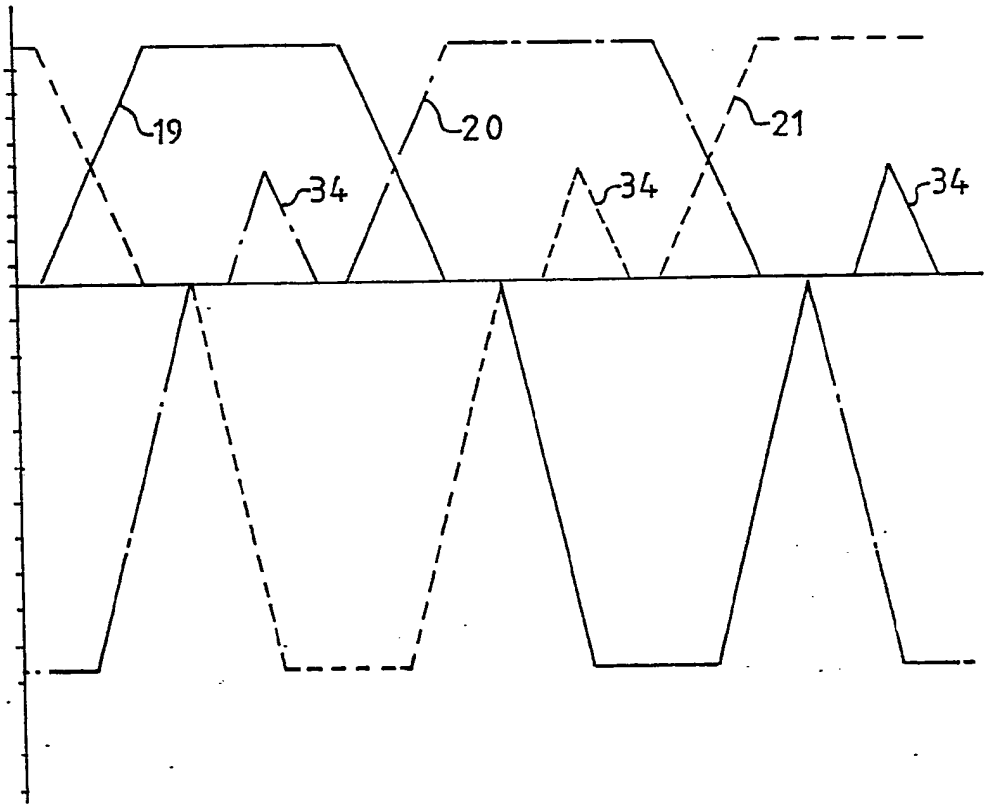


FIG. 2

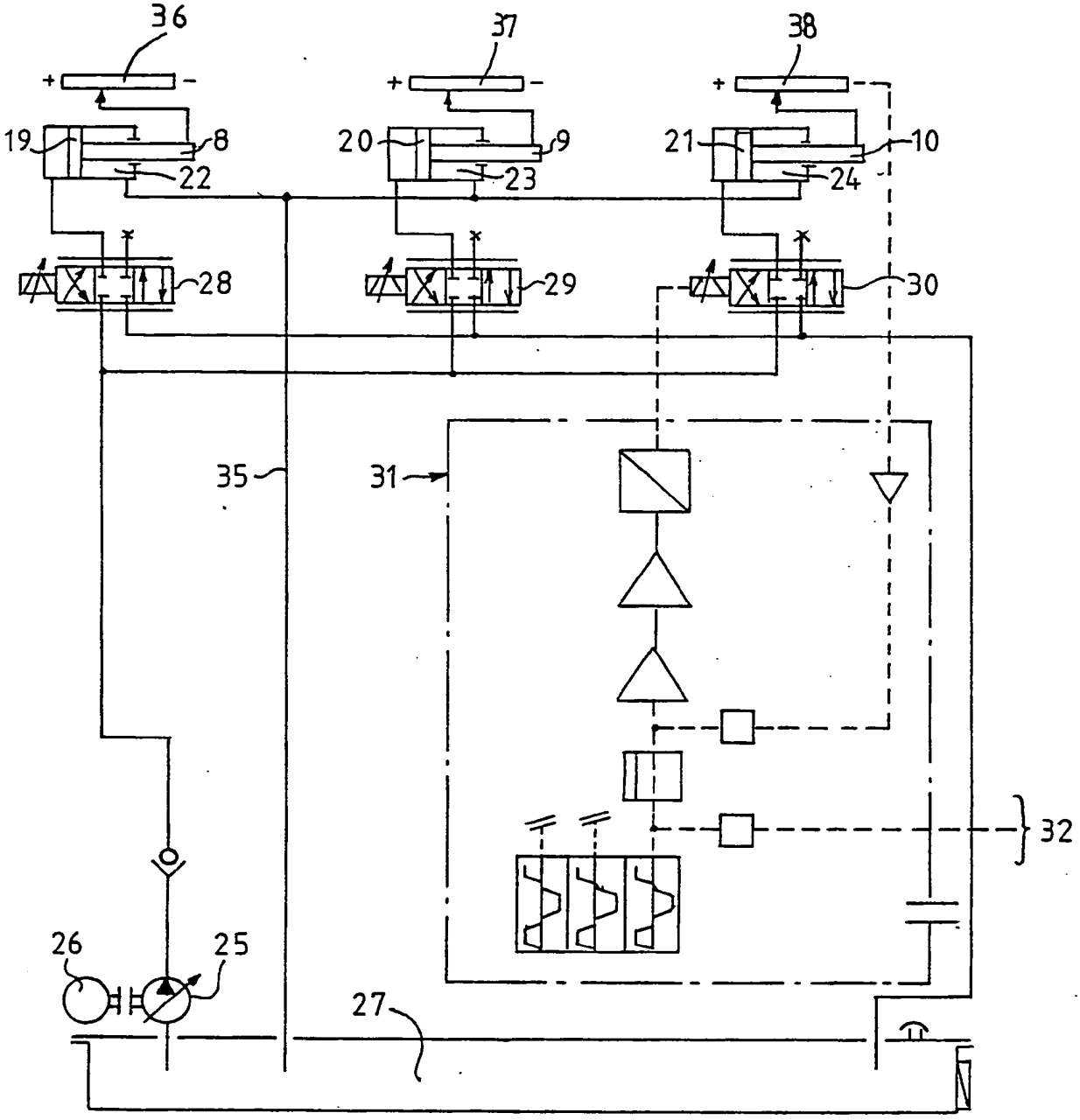


FIG. 3

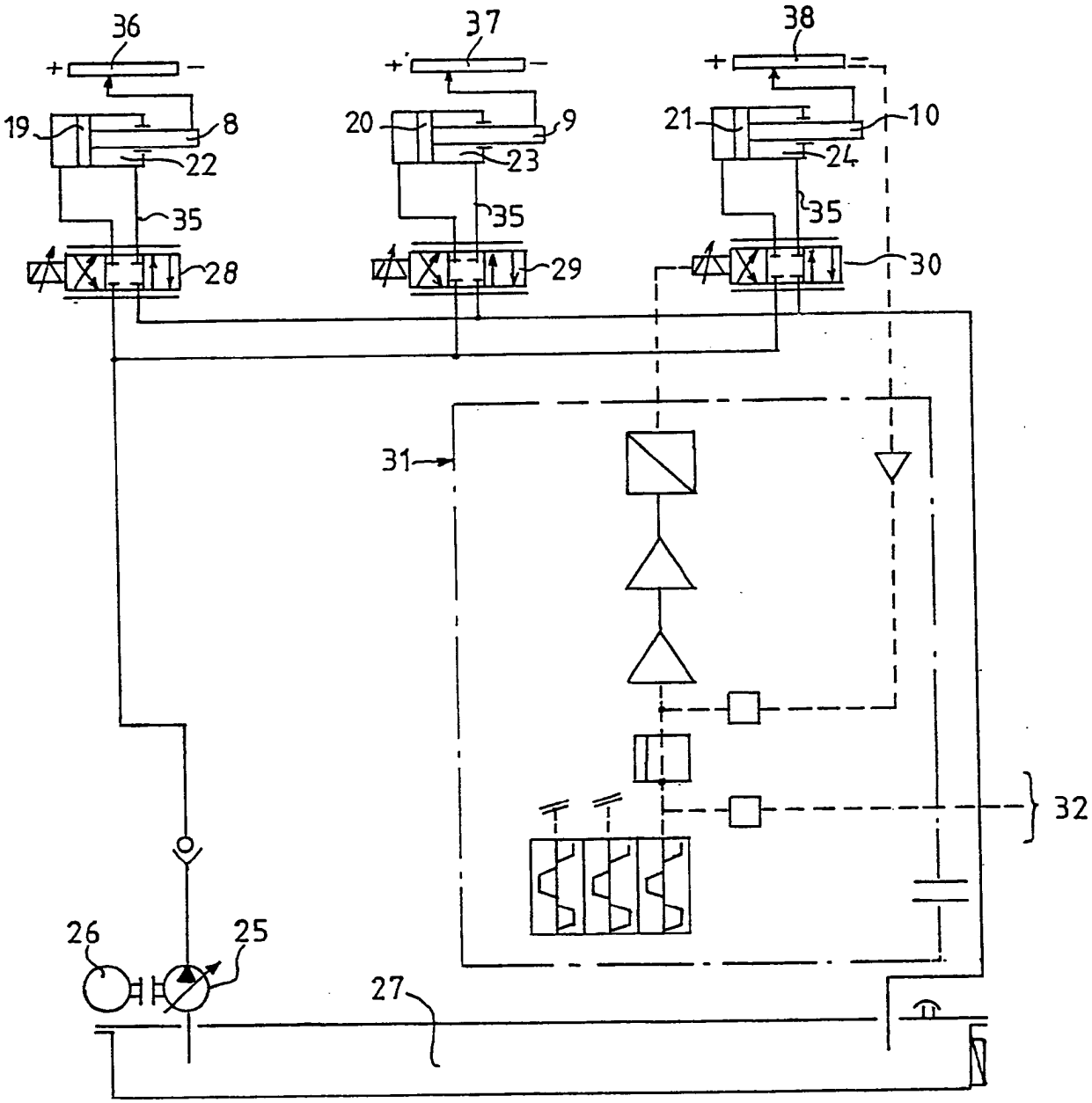


FIG. 4

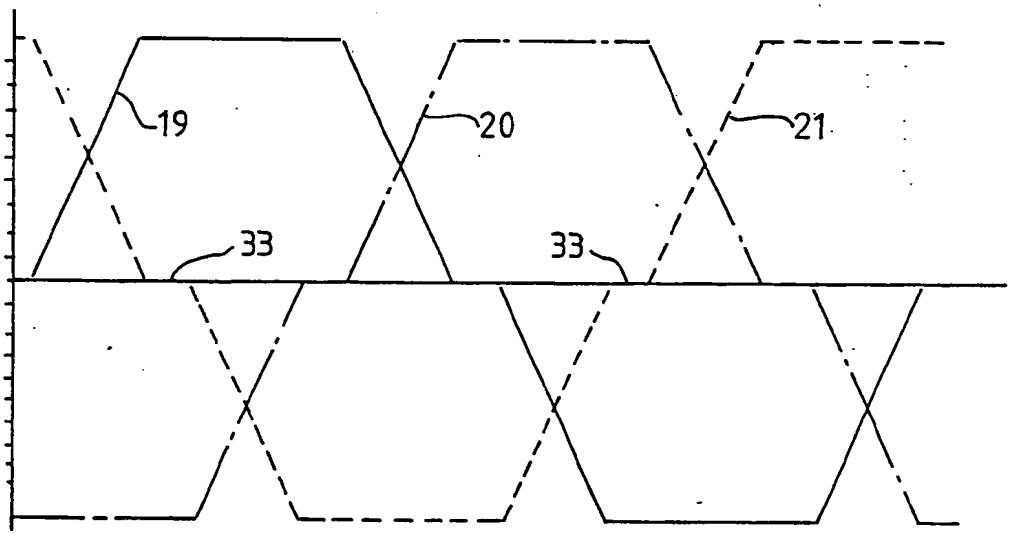
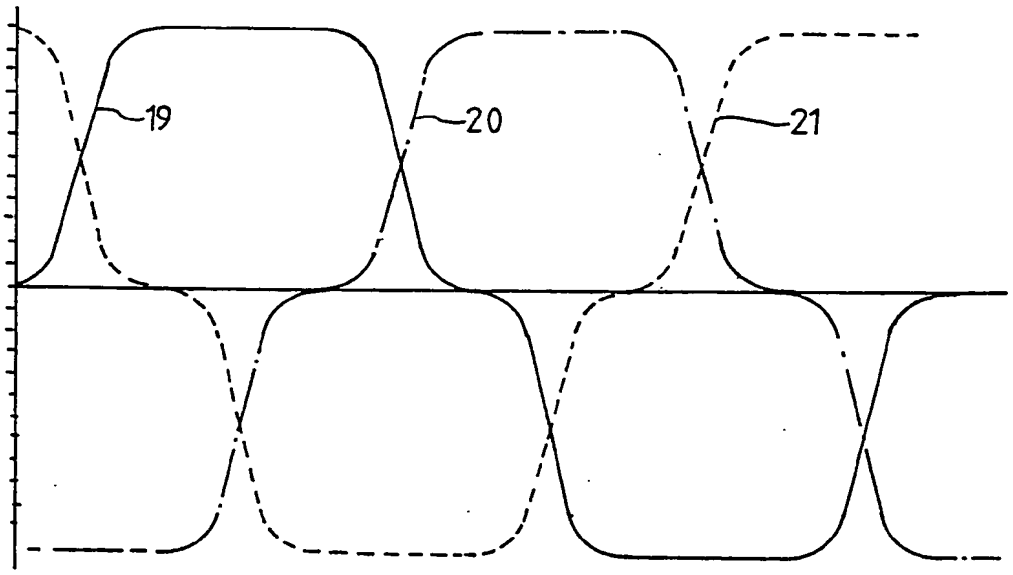


FIG. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 20 1340

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-4 527 954 (HALLIBURTON CO.) * Column 1, line 4 - column 5, line 63 *	1,4	F 04 B 11/00 F 04 B 9/10 F 04 B 7/00
A		2,3	

X	PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 224, 13th October 1984, page 55 M 331; & JP-A-59 105 977 (HITACHI SEISAKUSHO K.K.) 19-06-1984	1	
Y	Idem	4	

Y	PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 132, 20th June 1984, page 35 M 303; & JP-A-59 32 681 (HITACHI SEISAKUSHO K.K.) 22-02-1984	4	TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 04 B
A	Idem	1	

A	DE-B-1 500 511 (TOYODA) * Column 5, line 39 - column 6, line 65 *	1-3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-11-1986	VON ARX H.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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